A BIBLIOGRAPHY

OF

EXPLOSIVES.

COMPILED

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May 1-1918.

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A BIBLIOGRAPHY OF EXPLOSIVES.

EARLY HISTORY.

The history of gunpowder dates back as far as 660 A. D. when Kallinikos of Heliopolis is reported to have been its first user. The invention of this early incendiary mixture, " Greek-fire ", as it was called, is now unknown, but we do have one of the first formulas handed down to us from as early as 668 A. D. Greek-fire , known also as " Naptha " or " Sea-fire ", at this time consisted of a mixture of crude sulphur, resin, charcoal, paraffin, and oily-earths. A little later saltpeter was added, but this salt was of such poor quality that the resulting powder must have been unsatisfactory.

In reality these ancients merely used their mixtures for fire and smoke producers rather than for explosives. Later on Greeks placed the Greek-fire in iron vessels or in hollow stones, which they ignited and hurled from catapults or throwing machines. The Chinese used a similar igniting mass in iron pots as early as 1232, and later in 1299 the Mongolians used naptha in a similar manner at Bagdad. By 1249, the Saracens, also, knew how to use Greek-fire in the defense of their cities and palaces.

BLACK POWDERS.

Possibly Marcus Graecus is the first man to give the world a definite formula for black powders. In 1225 the following powder composition was used in rockets and fire-propellers:

Saltpeter----------66 2/3 %
Charcoal-----------22 2/9 %
Sulphur------------11 1/9 %

The Germans were the first people to use powder as a propellant. An old German military composition of the 13th century was:

Saltpeter----------74 %
Charcoal-----------16 %
Sulphur------------10 %

Along about this same period the Arabians were using their so called " Flying- fire " which was composed of 1 part resin, 1 part sulphur and 2 parts saltpeter. These ingredients were dissolved in linseed oil and then placed in hollow wooden tubes from which the enflamed mass poured when ignited. A little later the Arabian formula was changed to : Sulphur 1 part, charcoal 2 parts and saltpeter 6 parts.

An early recipe for making a " strong-powder " is given in an old German manuscript. The mixture is called " Codex Germanicus " and is as follows:

Saltpeter----------4 pounds.
Sulphur------------1 pound.
Charcoal-----------" "
" Salpratica "----1 ounce.
Camphor------------1/12 part.

" Salpratica " was made by heating a mixture of saltpeter, camphor and sal-ammonia in an earthen vessel and then scraping off the sublimate formed.

" Corned powder " or grained powder first made its appearance in 1425 and was called " serpentine powder " by the Germans at that time. It was made by grinding the ingredients with enough water to make a thick paste, which, after drying, was broken up into grains and polished to free them from dust.

After the invention of the firearm, the gunpowder industry developed very rapidly, and there has been a vast number of improvements and formulas set forward, up to the present time, for powders.

According to Berthollet's formula, the French Military powder of 1778 was made by mixing 16 parts of saltpeter, 1 part sulphur, and 3 parts of charcoal. A Brown Prismatic powder was made up with 77 % saltpeter, 20 % charcoal (from rye straw) and 3 % sulphur. This powder was used by the French as a propellant in 1882. Along about this time it was discovered that when black powder was pressed into various shapes such as cubes, plates, prisms, etc., a greater velocity of explosion was effected. This is the form of powder that was used in naval and coast defense service in the latter half of the 19th century. The French were the first to perfect blasting powders. An ordinary type consisted of 62 % saltpeter, 20 % sulphur and 18 % charcoal.

Slow burning blasting powder:

Saltpeter----------40 %
Sulphur----------30 %
Charcoal----------30 %

A " Strong " powder had:

Saltpeter----------72 %

Sulphur----------13 %
Charcoal---------15 %

The English, as well as the French brought forward their own formulas for black powder.

All of the following are blasting powders used in quarry or coal-mining.

Prism Black.

Saltpeter---------75 %
Sulphur-----------10 %
Charcoal----------15 %

Prism Brown.

Saltpeter---------79 %
Sulphur----------- 3 %
Charcoal----------18 %

E. X. E. Powder.

Saltpeter---------77.4 %
Sulphur----------- 5.0 %
Charcoal----------17.6 %

S. B. C. Powder.

Saltpeter---------79 %
Sulphur----------- 3 %
Charcoal---------- 8 %

PPC/68 Powder.

Saltpeter---------74 %
Sulphur-----------10 %
Charcoal----------16 %

P. P. C. /75 Powder.

Saltpeter---------74 %
Sulphur-----------10 %
Charcoal----------16 %

PP. C. /82 Powder.

Saltpeter---------78 %
Sulphur----------- 3 %
Charcoal----------19 %

P. PC/85 Powder.

PP.C./82 Powder.

Saltpeter----------78%
Sulphur------------ 3%
Charcoal-----------19%

P.PC/85 Powder.

Saltpeter----------80%
Charcoal-----------20%

The French P. P. Powder was composed of 78 % saltpeter, 3 % sulphur and 19 % charcoal.

Hirschmarke Powder.

Saltpeter----------78%
Sulphur------------10%
Charcoal-----------12%

This grade was a popular German sporting powder, while their military musket powder M/71 had a composition of

Saltpeter----------76%
Sulphur------------ 9%
Charcoal-----------15%

For large guns, both naval and field pieces, a brown prismatic powder was made. This powder contained:

Saltpeter----------75 to 80%
Sulphur------------ 3 %
Charcoal-----------19 to 20 %

Early Austrian blasting powders varied greatly in composition.

Saltpeter----------65 to 75 %
Sulphur------------10 to 15 %
Charcoal-----------15 to 20 %

Generally speaking, a blasting powder always contains less nitrate and more charcoal than a black powder for firearms. At present in Austria sodium

is desirable while for military work great propulsive force is the essential for a successful powder. Excess charcoal quickens combustion and the saltpeter tends to slow it up. The keeping qualities of a powder are jaded by a high suplhur content.

In the year of 1546 Military powder had the following comrosition:

	Large guns	Medium	Muskets.
Saltpeter	50 %	66.7 %	83.4 %
Sulphur	33.3%	20.0 %	8.3 %
Charcoal	16.7 %	13.3 %	8.3 %

Nine years later they were composed of 66 6/9 % saltpeter, 22 2/9 % sulphur and 11 1/9 % charcoal.

A century later, in 164 , they were:

	Large guns	Medium	Muskets.
Saltpeter	66.8 to70%	72.5 to 75.5%	78.7 to 85.6 %
Sulphur	16.6 "14%	13.0 " 11.2%	9.4 " 8.5%
Charcoal	16.6 "16%	14.5 " 13.3%	11.9 " 5.9%

In 1774:

	Large grained.	small grained.
Saltpeter	74.4 %	80 %
Sulphur	12.3 %	10 %
Charcoal	13.3 %	10 %

In 1900 the German powder contained 75 % saltpeter, 10 % sulphur, and 15 % charcoal; and a little while later, 75 % saltpeter, 11.5 % sulphur and 13. 5 % charcoal.

The military powders of the other Powders have progresses in a very similar manner, until at present time they use the following composition:

Rifle Powders.

Rifle Powders.

	saltpeter	sulphur	charcoal.
Austria-Hungary	75 %	10 %	15 %
Belgium	75.5 %	12.0 %	12.5 %
China	75 %	10 %	15 %
France	75 %	10 %	15 %
Germany	74 %	10 %	16 %
Great Britian	75 %	10 %	15 %
Holland	70 %	14 %	16 %
Italy	75 %	10 %	15 %
Persia	75 %	12.5 %	12.5 %
Portugal	75 %	10.7 %	13.6 %
Russia	75.7 %	10 %	13.6 %
Spain	75 %	12.5 %	12.5 %
Sweden	75 %	11 %	14 %
Switzerland	75 %	10 %	15 %
Turkey	75 %	10 %	15 %
United States	75 %	10 %	15 %

Diorrexin is a powder invented by Wenzel Pancera in which a part of the saltpeter is replaced by sodium nitrate. For blasting use.

Saltpeter	42.78 %
Sodium Nitrate	23.16 %
Sulphur	13.40 %
Charcoal	7.49 %
Beech Sawdust	10.97 %
Picric Acid	1.65 %
Moisture	0.55 %

Azotine, invented by A. Percsey is a composition of sodium nitrate, charcoal and petroleum residue. It is used in mining worl. Fehleison's Powder-- military:

Saltpeter	75 %
Sawdust	15 %
Charcoal	8 1/3 %
Potassium- Ferro-cyanide	1 2/3 %

Wynant's, a Belgian, has invented a very successful military and sporting powder by simply replacing 4/5 of the saltpeter with barium nitrate.

Petralite, invented by A. Prohaska, is composed of

of saltpeter, sulphur, woodpulp and powdered coke. This is a popular coal-mining powder.

Janite--- by A. Jahn, for mining:

Saltpeter----------70 %
Sulphur------------12 %
Lignite------------18 %
Picric Acid--------0.4 %
Potassium chlorate-0.4 %
Calcined soda------1 to 5 %

Carbo-azotine--- by Raymond Cahuc:

Saltpeter----------64 %
Sulphur------------12 %
Lamphlack---------- 7 %
Wood-pulp----------17 %
Ferrous sulphate---1 to 5 %

This powder is a slow burning one, used extensively in coal-mining. It produces a large volume of gaseous products but does not shatter the coal.

Amidogene-- by John Gemperle.

Saltpeter----------73 %
Charcoal---------- 8 %
Bran or starch----- 8 %
Magnesium sulphate- 1 %

This is a low powder explosive used also in coal-mining.

Pebble Powder- W. A.

Saltpeter----------74.67 %
Sulphur------------10.07 %
Charcoal-----------14.22 %

A. L. G. W. A. type Black Powder.

Saltpeter----------74.43 %
Sulphur------------10.09 %
Charcoal-----------14.29 %

F. G. W. A. Powder.

Saltpeter----------73.55 %
Sulphur------------10.02 %
Charcoal-----------14.59 %

Curtis and Harvey's No. 6.

Saltpeter	74.40 %
Sulphur	10.37 %
Charcoal	13.78 %

Spanish Cylindrical Powder.

Saltpeter	61.66 %
Sulphur	15.06 %
Charcoal	21.41 %

Bobbinite-- for coal-mining.

Saltpeter	65.31 %
Charcoal	19.52 %
Sulphur	2.63 %
Starch	8.73 %
Paraffin	3.35 %
Mositure	0.46 %

M. B. Powder is a black powder composition in which a part of the saltpeter is replaced by potassium perchlorate. It is used as a military explosive.

Waltham-Abbey-- Large-grained.

Saltpeter	74.95 %
Potassium sulphate	0.15 %
Sulphur	10.27 %
Charcoal	13.52 %
Mositure	1. 11 %

Waltham- Abbey-- Fine-grained.

Rifle Powder.

Saltpeter	75.04 %
Potassium sulfate	0.14 %
Sulphur	9 .93 %
Charcoal	14.09 %
Mositure	0.80 %

Waltham- Abbey-- Fine-grained.

Saltpeter	73.55 %
Potassium sulphate	0.36 %
Sulphur	10.02 %
Charcoal	14.59 %
Moisture	1.48 %

Spanish Spherical Pebble Powder.

Spanish Spherical Pebble-Powder.

Saltpeter	75.30 %
Potassium sulphate	0.27 %
Potassium chloride	0.02 %
Sulphur	12.42 %
Charcoal	11.34 %
Moisture	0.65 %

Bunsen and Schischkoff.

Sporting Powder.

Saltpeter	77.99 %
Sulphur	9.84 %
Charcoal	11.17 %

Karolyi-Austrian Cannon.

Saltpeter	73.78 %
Sulphur	12.80 %
Charcoal	13.39 %

Karolyi-Small Arms.

Saltpeter	77.15 %
Sulphur	8.63 %
Charcoal	14.27 %

Linck-Cannon Powder.

Saltpeter	74.66 %
Sulphur	12.49 %
Charcoal	12.85 %

Federow-Russian.

Saltpeter	74.19 %
Sulphur	9.89 %
Charcoal	14.83 %
Moisture	1.10 %

CHAPTER II.

DYNAMITE.

The name dynamite is generally applied to those explosives consisting entirely or in part of nitroglycerin absorbed in some sort of porous material. This absorbent base may be either inert like chalk and kieselguhr, or active like charcoal, gunpowder, nitrates, or even guncotton and other nitro-compounds. However active, this base may be the chief source , or seat of the explosion of a dynamite is the nitroglycerin.

Trinitroglycerin was first obtained by A. Sobrero in Turin, but it was the great A. Nobel, of Stockholm, who really mastered the dangerous liquid by absorbing it in infusorial earth in 1863. Nitroglycerin is a trinitric ether of glycerin and is made by nitrating the glycerin with mixed acid consisting of 95 % nitric acid and 96 % sulphuric acid. It freezes at 13°C, and thus causes much trouble in cold weather when used as straight dynamite.

" Low-freezing " dynamite has overcome this difficulty however to a great extent. The first type is made by lowering the freezing point of the nitroglycerin by adding such substances as nitrobenzene, di-nitrotoluene, etc. up to 10 % of the nitroglycerin content. The second type is made by preventing crystallization of the nitroglycerin by super-cooling.

To bring this about, the mixture is caused to gelatinize by the addition of soluble nitro-cellulose

Ordinary " Guhr dynamite " is composed of 75 % nitroglycerin and 25 % kieselguhr. The sticky mass is rubbed through sieves and pressed into cylinders which are later cut into sticks. These sticks are then wrapped in paraffined paper, crimped and re-dipped in paraffin. Moisture is exceedingly injurious to dynamite because it displaces the nitroglycerin from the absorbent.

In 1875, it was A. Nobel again who made a remarkable advance in the field of explosives. This time he discovered explosive gelatin which was first made up of 90 to 93 % nitroglycerin and 7 yo 10 % of a soluble nitro-cellulose. This new explosive was not affected by water, left no solid residue and was the most powerful known. Gelatin is used to shatter the most resistant rock formation in construction and quarry work.

The next step , of course, was gelatin-dynamite. This is the most important of all nitroglycerin explosives, is easy to handle, and is very cheap.

The commosition varies within wide limits.

Common Type.

62.5 % Nitroglycerin.)
2.5 % Collodain-cotton.)
25.5 % Sodium nitrate.) gelatinized.
8.7 % Meal.)
0.8 % Soda.)

Ammon-Explosive Gelatin.

40 to 50 % Gelatinized nitroglycerin.
46 to 55 % Ammonium nitrate.
3.5 % to 5 % Meal.
0.5 % Soda.

Kohlenkarbonite-Coal Mining.

Nitroglycerin----------25 %
Saltpeter--------------34 %
Meal-------------------39.5 %
Barium nitrate--------- 1 %
Soda-------------------- 0.5 %

In some coal mining operation ordinary dynamites are not applicable, but another special type containing certain salts with water of crystallization are used. Such salts as Glauber's Salts, Magnesium Sulphate, and Ammonium Oxalate have been used,and their function is to extinguish any flame which may arise from the explosion. This type of explosives are termed "Wetter-dynamites, and a common one used in Great Britain consists of:

Nitroglycerin----------31 to 34 %
Kieselguhr-------------11 to 14 %
Magnesium sulphate-----47 to 51 %
Saltpeter--------------- 4 to 6 %

These powders, however, possess a low explosive effect and so are not very much in demand by coal miners.

Wetterdyn.

Nitroglycerin----------52 %
Dieselguhr----------13 %
Crystallized soda------35 %

Grisoutine D.

Nitroglycerin----------40 to 45 %
Dieselguhr----------10 to 12 %
Crystal Magnesium sulphate------42 to 49 %
Soda---------- 1 %

Grisoutine.

Nitroglycerin----------42 to 46 %
Wood Meal---------- 9 to 12 %
Crystal Magnesium sulphate----44 to 46 %

Nobel's Ardeer Powder.

Nitroglycerin----------31 to 43 %
Kieselguhr----------11 to 14 %
Saltpeter---------- 4 to 6 %

OTHER DYNAMITES.

Dynamite I.

Nitroglycerin----------75 %
Kieselguhr----------25 %

Dynamite II.

Nitroglycerin----------18 %
Saltpeter----------72 %
Charcoal----------10 %

Rhexite.

Nitroglycerin----------64 to 67 %
Sodium nitrate---------- 18 %
Decayed Wood---------- 11 %
Wood Meal---------- 4 to 7 %

Dynammon.

Nitroglycerin	45 %
Ammonium nitrate	47.2 %
Lignite	7.8 %

Gelignite.

Nitroglycerin	53 to 63 %
Collodain-cotton	3 to 5 %
Saltpeter	26 to 34 %
Wood Meal	6 to 9 %
Chalk	0. 5 %

Ammon-Sprenggelatin.

Nitroglycerin	38 to 47 %
Collodian-cotton	2 to 3 %
Ammonium nitrate	46 to 55 %
Meal	3.5 to 5 %
Soda	0.5 %

Phoenix I.

Nitroglycerin	30 %
Sodium nitrate	32 %
Rye Meal	38 %

Safety Gelatin Dynamite.

Nitroglycerin	29.6 %
Collodian-cotton	0.4 %
Ammonium nitrate	32 %
Saltpeter	6 %
Soap	10 %
Rye Meal	17 %
" Liquid Carbohydrates"	.3 %
Wood-Meal	2 %

Gel-carbonite.

Nitroglycerin	25.3 parts.
Collodian-cotton	0.7 parts.
Leimglycerin gelatin	6.9 parts.

Fugurite is a dynamite having magnesium carbonate as an absorbent, and " White-Dyn " another dynamite of 60 % strength, makes use of lime-guhr as an absorbent.

" Champions " dynamite consisted of 55 % nitroglycerin and 45 % of boghead coal ashes. A Great

variety of minerals such as randanite, earths, chalk and various complex silicates have been used as nitroglycerin absorbents in Europe, but the American powder manufacturers lean toward the active absorbents, however,

The American "Giant Powder" is composed of :

Nitroglycerin----------75 parts.
Kieselguhr----------25 parts.
Soda----------1/2 part.

Meganite--by Wilhelm Schuckher.

Nitroglycerin----------60 %
Nitrated Wood----------10 %
Nitrated vegetable ivory----------10 %
Sodium nitrate----------20 %

Dynamite of Vonges-- (French) .

Nitroglycerin----------75 %
Randanite(weathered feldspar)--------20.8 %
Quartz---------- 3.8 %
Magnesium carbonite---- 0.4 %

Carbonite.-- (By Schmidt and Pichel).

Nitroglycerin----------25 %
Wood-meal----------40.5 %
Sodium nitrate----------34 %
Sodium carbonate-------- 0.5 %

Stonite-- (by Schmidt and Pichel.)

Nitroglycerin----------68 %
Kieselguhr----------20 %
Wood-meal---------- 4 %
Saltpeter---------- 8 %

Hercules Powder.

Nitroglycerin----------40 %
Sodium nitrate----------45 %
Wood pulp----------11 %
Sodium chloride-------- 1 %
Magnesium carbonate---- 1 %
Moisture---------- 2 %

Vulcan Powder. (American) .

Nitroglycerin	30.0 %
Sodium nitrate	52.5 %
Sulphur	7.0 %
Charcoal	10.5 %

Judson Powder. (American).

Nitroglycerin	5 %
Sodium nitrate	64 %
Sulphur	16 %
Cannel Coal	15 %

Pulverulent Ammonium Nitrate.

Nitroglycerin	20 %
Ammonium nitrate	25 %
Sodium nitrate	36 %
Roasted Rye-flour	18 %

Dynamite No.3 (Used for giant mines.) (Military)

Nitroglycerin- 15 %.

85 % of an absorbent consisting of:

Sodium nitrate	84.5 %
Coal	15 %
Sodium carbonate	0.5 %

Carbo-Dynamite of Reid and Borland.

Nitroglycerin	90 %
Cork charcoal	10 %

Gelignite II.

65 % Gelatin: 96 2/13 % Nitroglycerin. / 3 11/13 % Collodian-Cotton.

35 % Absorbent: 75 % Sodium nitrate. / 24 % Wood pulp. / 1 % Soda.

Ardeer Dynamite.

Nitroglycerin	73.62 %
Kieselguhr	25.70 %
Ammonium carbonate	0.19 %
Other soluble matter	0.11 %
Moisture	0.38 %

Atlas Powder No. 1.

Nitroglycerin----------29.8 %
Wood-sawdust----------63.8 %
Moisture---------- 6.4 %

Atlas Powder No. 2.

Nitroglycerin----------71.6 %
Wood-sawdust----------24.9 %
Moisture---------- 3.5 %

AMERICAN DYNAMITES.

I------60 % Grade.

Nitroglycerin----------53.5 to 65.1 %
Wood-pulp----------14.2 to 21.0 %
Sodium nitrate----------16.0 to 29.8 %
Moisture---------- 1.16 to 3.18 %

2------50 % Grade.

Nitroglycerin----------40.3 to 50.1 %
Woodpulp----------11.[illegible] to 13.4 %
Sodium Nitrate----------32.6 to 33.8 %
Moisture----------1.97 to 2.9 %

3------40 % Grade.

Nitroglycerin----------34.8 to 41.9 %
Wood pulp---------- 7.7 to 13.9 %
Sodium Nitrate----------38.4 to 50.2%
Moisture----------0.80 to 3.6 %

4------30 % Grade.

Nitroglycerin----------29.7 to 32.5 %
Wood pulp---------- 7.9 to 10.2 %
Sodium Nitrate----------52.6 to 60.1 %
Moisture----------1.09 to 1.69 %

Lygdyn--- (South Africa).

Nitroglycerin----------40 %
Wood Meal----------13 %
Sodium nitrate----------45 %
Flour---------- 2 %

Ammonia-dynamites. (American).

I-----30 % Strength.

Nitroglycerin----------15 %
Ammonium nitrate-------15 %
Sodium nitrate---------51 %

Combustibles----------18 %
Chalk or Zinc Oxide--- 1 %

2-------35 % Strength.

Nitroglycerin---------20 %
Ammonium nitrate------15 %
Sodium nitrate--------48 %
Combustibles----------16 %
Chalk or Zinc Oxide--- 1 %

3-------40 % Strength.

Nitroglycerin---------22 %
Ammonium nitrate------20 %
Sodium nitrate--------42 %
Combustibles----------15 %
Chalk or Zinc Oxide--- 1 %

4-------50 % Strength.

Nitroglycerin---------27 %
Ammonium nitrate------25 %
Sodium nitrate--------36 %
Combustibles----------11 %
Chalk or Zinc Oxide--- 1 %

5-------60 % Strength.

Nitroglycerin---------35 %
Ammonium nitrate------30 %
Sodium nitrate--------24 %
Combustibles----------10 %
Chalk or Zinc Oxide--- 1 %

Judson Powder. R. R. P.

Nitroglycerin--------- 5 %
Sodium nitrate--------60 %
Sulphur, coal and resin
----------35 %

Blasting-gelatin.

Nitroglycerin---------91.5 %
Collodian cotton------ 8.0 %
Chalk----------------- 0.2 %
Moisture-------------- 0.3 %

Gelatin-dynamite.

Nitroglycerin---------74.5 %
Collodian cotton------ 5. 5 %
Wood Meal------------- 4.0 %
Saltpeter-------------15.5 %

Chalk----------0.2 %
Moisture----------0.3 %

Munroe and Hall Dynamite.

Nitroglycerin----------33 %
Nitro-cellulose-------- 1 %
Sodium nitrate---------54 %
Flour----------11 %
Chalk---------- 1 %

Forcite-----a thin blasting gelatin.

I.---- " Extra ".

Nitroglycerin----------64 %
Nitro-cellulose-------- 3.5%
Ammonium nitrate-------25 %
Wood Meal---------- 6.5 %
Magnesium oxide-------- 1 %

2.----- " Superieur. "

Nitroglycerin----------64 %
Nitro-cellulose-------- 3 %
Sodium nitrate---------24 %
Wood Meal---------- 8 %
Magnesium oxide-------- 1 %

3.----- No.I

Nitroglycerin----------49 %
Nitro-cellulose-------- 2 %
Sodium nitrate---------36 %
Wood Meal----------13 %

4.----- No.2.

Nitroglycerin----------36 %
Nitro-cellulose-------- 3 %
Sodium nitrate---------35 %
Wood Meal----------11 %
Magnesium Oxide-------- 1 %
Rye bran----------14 %

German " Low-freezing " Dynamite.

Dyn. I

Nitroglycerin----------55 %
Nitro-cellulose-------- 2 %
Nitro-toluene----------10 %
Wood Meal---------- 8 %
Sodium nitrate---------24 %
Caput mortuum---------- 0.5 %
Sodium carbonate------- 0.5 %

Dyn. II.

Dyn. II.

Nitroglycerin----------38.5 %
Nitro-cellulose-------- 1.5 %
Nitro-toluene----------8.0 %
Wood meal---------------4.16 %
Rye flour---------------3.12 %
Sodium nitrate----------43.68%
Lamp black-------------- 0.52%
Caput mortum------------ 0.52%

French " Low-freezing " Dynamite.

Nitroglycerin----------66.4 %
Nitro-glycol-----------16.6 %
Nitro-cellulose-------- 5.0 %
Saltpeter--------------10.0 %
Wood meal-------------- 2 %

Antigrisonteuse. (Belgian Dynamite.)

Nitroglycerin----------44 %
Cellulose--------------12 %
Sodium sulphate--------44 %

Grisoutite.

Nitroglycerin----------44 %
Cellulose--------------12 %
Magnesium sulphate-----44 %

Grisoutite II is exactly like antigrisouteuse.

Carbonite II.

Nitroglycerin----------26 %
Saltpeter--------------33 %
Barium nitrate---------33 %
Wood Meal--------------40.5 %
Sulphuretted benzene--- 0.25%
Chalk------------------ 0.25%
Soda------------------- 0.25%

Tutol.

Nitroglycerin----------25 %
Saltpeter--------------33 %
Barium nitrate--------- 2 %
Wood meal--------------40 %
Sodium bicarbonite----- 0.25%

Kolax.

Nitroglycerin----------25 %
Saltpeter--------------26 %
Barium nitrate--------- 5 %

Wood meal----------34 %
Starch-------------10 %

Antigel di-Surete.

Nitroglycerin----------25 %
Sodium nitrate---------20 %
Dinitro-toluene--------15 %
Ammonium sulphate------ 5 %
Cellulose--------------35 %
Wood meal--------------35 %

Minite.

Nitroglycerin----------25 %
Saltpeter--------------35 %
Flour------------------39.5 %
Soda-------------------- 0.5 %

Minerite and Colinite.

Nitroglycerin----------25%
Saltpeter--------------34 %
Barium nitrate--------- 1 %
Flour------------------38.5 %
Tan-meal---------------- 1 %
Soda-------------------- 0.5 %

Securophore III. is the same as Minerite, except that wood meal is substituted in it for tan-meal.

Cambrite.

Nitroglycerin----------23 %
Saltpeter--------------27 %
Barium nitrate--------- 3.5 %
Wood meal--------------38 %
Ammonium oxalate------- 8 %
Chalk------------------- 0.5 %

Super-Kolax.

I-- No.I

Nitroglycerin----------25.5 %
Saltpeter--------------25.5 %
Barium nitrate--------- 5 %
Wood meal--------------30 %
Ammonium oxalate------- 7 %

No.2

Nitroglycerin----------28.5 %
Collodian cotton------- 1 %
Saltpeter--------------16.5 %
Barium nitrate--------- 5 %

Wood-meal----------31 %
Starch---------- 8.5 %
Ammonium oxalate----9.5 %

Britonite.

Nitroglycerin----------24 %
Saltpeter----------30 %
Wood-meal----------38 %
Ammonium oxalate------- 8 %

French Grisontines.--- used in coal-mining.

" Couche ".

Nitroglycerin----------12 %
Collodian cotton------- 0.5 %
Ammonium nitrate-------87.5 %

Couche au Salpetre.

Nitroglycerin----------12.0 %
Collodian cotton--------0.5 %
Ammonium nitrate-------82.5 %
Saltpeter---------- 5.0 %

" Roche ".

Nitroglycerin----------29 %
Collodian cotton------- 1 %
Ammonium nitrate-------70 %

Roche au Salpetre.

Nitroglycerin----------29 %
Collodian cotton------- 1 %
Ammonium nitrate-------65 %
Saltpeter---------- 5 %

Carbonite I.

Nitroglycerin----------25 %
Sodium nitrate---------30 1/2 %
Potassium dichromate--- 5 %
Wheat flour----------39 1/2 %

Gelatin-Dynamite III.

Nitroglycerin----------28 %
Collodian cotton------- 0.7 %
Di-nitro-toluene-------11.0 %
Ammonium nitrate-------37.0 %
Rye flour---------- 4.0 %
Sodium chloride--------19.3 %

Rhenish Dynamite.-- Used in coal mining.

70 parts of a solution of 2 or 3 % naphthalene in nitroglycerin.

3 parts of chalk.

7 parts of barium sulphate.

20 parts of kieselguhr.

Snyder's Explosive.

Nitroglycerin----------94 %
Soluble gun cotton----- 6 %

This powder is mixed with camphor ot render it insensitive. It is used to load big gun shells. It is somewhat safe, and is extremely powerful.

Celtite.

Nitroglycerin----------56 to 59 %
Nitro-cotton---------- 2 to 3.5 %
Saltpeter--------------17 to 21 %
Wood-meal-------------- 8.to 9 %
Ammonium oxalate-------11 to 13 %
Moisture--------------- 0.5 to 1.5 %

Dualine.

Nitroglycerin----------50 %
Sawdust----------------30 %
Saltpeter--------------20 %

Rendrock.

Nitroglycerin----------40 %
Saltpeter--------------40 %
Wood pulp--------------13 %
Paraffin or pitch------ 7 %

Geloxite.

Nitroglycerin----------64 to 54 %
Nitro cotton---------- 5 to 4 %
Saltpeter--------------22 to 13 %
Ammonium oxalate-------15 to 12 %
Red ochre--------------- 1 to 0 %
Wood meal--------------- 7 to 4 %

Giant Powder II.

Nitroglycerin	40 %
Sodium nitrate	40 %
Rosin	6 %
Sulphur	6 %
Guhr	8 %

Dynamite-de-Trauzel.

Nitroglycerin	75 parts.
guncotton	25 parts.
Charcoal	2 parts.

Stowite.

Nitroglycerin	58 to 61 %
Nitro-cotton	4.5 to 5 %
Saltpeter	18 to 20 %
Wood meal	6 to 7 %
Ammonium oxalate	11 to 15 %

Kynite.

Nitroglycerin	24 to 26 %
Wood pulp	2.5 to 3.5 %
Starch	32.5 to 35 %
Barium nitrate	31.5 to 34.5 %
Chalk	0 to 0.5 %
Moisture	3 to 6 %

Atlas Powder, A.

Nitroglycerin	75 %
Sodium nitrate	2 %
Wood fiber	21 %
Magnesium carbonate	2 %

Atlas Powder, B.

Nitroglycerin	50 %
Sodium nitrate	34 %
Magnesium carbonate	2 %
Wood fiber	14 %

Atlas Powder, B+.

Moisture	0.2 %
Nitroglycerin	61.1 %
Wood pulp	14.1 %
Magnesium oxide	3.0 %
Saltpeter	21.6 %

Atlas Powder, C +.

Moisture	1.0 %
Nitroglycerin	45.7 %

Wood pulp----------10.5 %
Chalk---------- 1.9 %
Saltpeter----------40.9 %

Safety Nitro Powder.

Nitroglycerin----------68.81 %
Sodium nitrate---------18.35 %
Wood pulp--------------12.84 %

For railroad work and for bank blasting there is a low grade dynamite manufactured in the United States. Its composition is :

Nitroglycerin---------- 5 %
Sodium nitrate---------47 1/2 %
Soft coal powder-------47 1/2 %

Blasting Explosive.

Nitroglycerin----------25 %
Di-nitro monochlorhydrin-------- 5 %
Mono-nitro-monochlorhydrin---------10 %
Dihydrotoluene--------- 3.5 %
Collodian cotton------- 1.5 %
Ammonium nitrate-------20 %
Saltpeter--------------10 %
Aluminum stearate------ 9 %
Sodium chloride--------16 %

Saxonite-Blasting.

Nitroglycerin----------42.5 to 62 %
Nitro-cellulose-------- 2.5 to 5 %
Saltpeter--------------16 to 27.5 %
Wood meal-------------- 3.5 to 8 %
Chalk------------------ 0 to 0.5 %
Ammonium oxalate------- 9 to 27 %

Samsonite.

Nitroglycerin----------57 to 60 %
Nitro-cellulose-------- 3 to 4 %
Saltpeter--------------17 to 19 %
Wood meal-------------- 5 to 7 %
Ammonium oxalate-------12.5 to 14.5 %
Moisture--------------- 0 to 1.5 %

Other similar explosives are Rippite, Arkite #I, Cornish Powder and Sivalite.

Arkite # 2-- Blasting.

Nitroglycerin----------32 %
Nitro-cellulose-------- 1 %
Saltpeter--------------27 %
Wood meal--------------10 %
Ammonium oxalate-------30 %

Duxite--Blasting.

Nitroglycerin----------32 %
Nitro-cellulose-------- 1 %
Sodium nitrate---------28 %
Wood meal--------------10 %
Ammonium oxalate-------29 %

Albionite--coal mining.

Nitroglycerin----------82 %
Gun cotton------------- 6 %
Saltpeter-------------- 9 1/2 %
Ammonium oxalate-------15 %
Wood meal--------------- 2 1/2 %

Cliffite--- Coal mining.

Nitroglycerin----------46 1/2 %
Gun cotton------------- 3 %
Starch-----------------43 %
Moisture---------------- 7 1/2 %

Dragonite-- coal mining.

Nitroglycerin----------35 1/2 %
Nitro-cellulose-------- 2 1/2%
Saltpeter--------------44 1/2 %
Wood meal--------------12 1/4 %
Vaseline---------------- 5 1/2 %

Extra-Carbonite-Coal.

Nitroglycerin----------35 %
Guncotton--------------- 0.3 %
Saltpeter--------------25 1/2 %
Wood meal--------------33 %
Barium nitrate--------- 4 %
Sodium carbonite------- 1/4 %
Moisture---------------- 3 1/2 %

Fracturite-----Coal.

Nitroglycerin----------52 1/2 %
Guncotton--------------- 3 1/2 %
Saltpeter--------------23 %
Ammonium oxalate-------15 %
Wood meal--------------- 6 %

Haylite No. I. -----Blasting.

Nitroglycerin----------	26 %
Guncotton----------	1 %
Saltpeter----------	20 %
Ammonium oxalate-------	11 %
Wood meal----------	13 %
Barium nitrate---------	20 %
Mineral jelly----------	7 %

Normanite-----Blasting.

Nitroglycerin----------	33 1/2 %
Guncotton----------	1 1/2 %
Saltpeter----------	44 1/2 %
Ammonium oxalate-------	11 %
Wood meal----------	8 %
Charcoal----------	1 1/2 %

Oaklite--No. I.

Nitroglycerin----------	25 %
Guncotton----------	1 %
Saltpeter----------	34 %
Wood meal----------	35 %
Magnesium carbonate----	0.5 %
Moisture----------	5 %

Russelite.

Nitroglycerin----------	41 %
Guncotton----------	2.25 %
Saltpeter----------	25 %
Ammonium oxalate-------	23 %
Wood meal----------	4 %
Chalk----------	0.5%
Tri-nitro-toluene------	5 1/2 %

Britonite II.

Nitroglycerin----------	26 %
Saltpeter----------	32.5 %
Wood meal----------	41 %

Clydite.

Nitroglycerin----------	25%
Nitrates----------	34 %
Wood meal----------	40 %
Ammonium oxalate-------	8 parts.

Pit-ite.

Nitroglycerin----------	26 %
Nitrates----------	33 %
Wood meal----------	41.5 %

Sodium carbonate---------- 1 %
Chalk---------- 2.5 %

Tutol II.

Nitroglycerin----------25 %
Saltpeter----------33.25 %
Nitrate of soda-------- 2 %
Wood meal----------36.5 %
Sodium bicarbonate----- 0.5 %
Moisture---------- 4 %

III-----NITRO CELLULOSE POWDERS.

Nearly all smokeless powders contain as their chief active constituent, nitre-cellulose. This very important explosive was first made by C. F. Shonbein in 1846 by nitrating cotton with strong nitric acid. However, it was not until 1886 that a satisfactory product was obtained, which could be substituted for black powder. Nitro-cellulose is not a definite chemical compound, but rather a series of nitric esters of cellulose. It can be made by nitrating cotton, flax, wood fibers, jute, straw, etc., with mixed acids. The lower nitrocelluloses, collodian cotton, pyro-cotton etc., are soluble in ether-alcohol mixtures while the higher nitration products are dissolved by acetone and glacial acetic acid. At present, the nitro-celluloses are used in a great number of industries in the manufacture of such articles as celluloid, photographic films, artificial silks, filter material for strong acids, etc. In the military field, it is used, as noted before, in most types of smokeless powder, and in a highly compressed form, to make submarine mines, torpedoes,etc.

E. Schultze of Potasam made a powder from nitrated wood fibers in 1846. A little later , (1882) W. F. Reid, an English chemist, placed his"E . C. " Powder, which was made by granulating guncotton and dipping in ether-alcohol mixture, on the market. It was also

along about this time that the celebrated " J. B. " Powder came out. This powder was made by dipping the nitro-cellulose in camphor.

The first smokeless powder, however, was invented by Vieille in 1886. This French chemist dissolved the guncotton in sulphuric ether mixed with picric acid. It was a powerful powder, but was very sensitive and not very stable.

Schultze Powder I.

100 parts of pyroxylin.
22 1/2 parts of saltpeter.
7 1/2 parts of barium nitrate.

The pyroxylin is a soluble nitrated wood which is soaked in the strong nitrate solution and dried slowly.

Schultze Powder II.

1 part nitro-resin.
5 parts nitro-cellulose.
6 parts saltpeter.

The powder is mixed, granulated, and glazed with paraffin or collodian cotton.

The Lannoy & Co. manufactures a blasting powder called " White Powder ", or " Lithofracteur ", which is composed of:

65 % sodium nitrate.
13 % sulphur.
22 " nitrated sawdust or bran.

Bautzen Powder--- E. Frantz & Co.

50 % nitrated wood.
50 % saltpeter.

Used for blasting purposes.

In order to supply more oxygen for the complete combustion of nitro-cellulose, Coxthupe and Caldwell, in 1851, dipped the granulated material in a strong solution of potassium chlorate, and dried it. Later, Combs mixed four parts of potassium chlorate with five parts of the cotton. He also substituted saltpeter for the potassium chlorate, and again in another powder it was replaced by 3 1/2 parts of sodium nitrate.

Potentite, a compressed mixture of cotton and saltpeter, was made by Abel, and was used for blasting.

Tonite-- (also German Miner's Cartridges.)

52 1/2 parts of guncotton.
45 1/2 parts of barium nitrate.

Another nitro-explosive which is coming into more general use is nitro-hydro- cellulose. It was first prepared by Aime Girard by soaking cotton in sulphuric acid of 1.45 % specific gravity, for 12 hours , at 59°F., and then nitrating by means of strong nitric acid. This explosive is much more sensitive to shocks than nitro-cellulose, and is used in detonating fuses, primers, and blasting gelatin. The gelatin has a composition of 60 % nitroglycerin and 40 % nitro-hydro- cellulose.

Collodian cotton, the coluble variety of nitro-cellulose, is usually a mixture of several types of nitration products. The following specific ones have been identified:

$C_{12} H_{15} O_5 (ONO_2)$ = Penta-nitro-cellulose.

$C_{12} H_{16} O_6 (ONO_2)_4$ = Tetra-nitro-cellulose.

$C_{12} H_{17} O_7 (ONO_2)_3$ = Tri-nitro-cellulose.

$C_{12} H_{18} O_8 (ONO_2)_2$ = Di-nitro-cellulose.

The lower nitration products are used for photographic films because they are completely soluble in ether, and are absolutely clear. The higher products may be used for gelatin - dynamite and smokeless powders because they are strong and tough.

Pyro-paper, which is made by treating a pure, unsized paper with sulphuric-nitric mixture, for two minutes, is an explosive which has not come into very general use as yet.

Of all the nitro-compounds derived from substances of the cellulose type, those made from starch are the most powerful and most sensitive.

When starch is treated with mixed acids, a series of products is formed simulatneously. Three varieties have been identified:

$C_{12} H_{19} (NO_2) O_{10}$ = Mono -nitro-starch.

$C_{12} H_{18} (NO_2) O_{10}$ = Di-nitro-starch.

$C_{12} H_{16} (NO_2)_4 O_{10}$ = Tetra-nitro-starch.

Several explosive sugars have been prepared, but their use has been very limited up to the present time.

Fulminating sugar, also called nitro-cane sugar or nitro- saccharose, is made by allowing 2 parts of strong sulphuric acid and one part of strong nitric acid to act on cane sugar at 54°F. It is very likely that the resulting product is a nitric ether, but this

has not been definitely established. Fulminating sugar is used in certain kinds of fireworks.

Nitro-lactose is made by treating lactose with the mixed acids. No commercial use has been found as yet

Nitro -mannite $C_6H_8(NO_3)_6$---- This nitro-sugar is a very high explosive which is extermely easy to detonate by blow, but is is much less sensitive to friction and heat than mercury fulminate. It has found no commercial use because no satisfactory means of purification have been derived.

SMOKELESS POWDERS.

" J. B. " Powder:

Di-nitro-cellulose----------	68 %
Saltpeter----------	6 %
Barium nitrate----------	25 %
Ultramarine----------	1 %

Camphor was added to the dry powder in the proportion of 1 to 10. This powder was the favorite sporting powder for a number of years.

For a number of years after Vieilles first smokeless powder came out in 1886, all nitro-cellulose powders were divided into two classes, namely (a) Flake Powders, and (b) Granulated powders.

(a) Flake Powders-- (Pure guncotton in flakes.)

German Rifle.
French Rifle.
Austro-Hungarian Rifle.
Swiss Rifle.
Wetteren Powder.
Troisdorf Powder.
Von Forster Powder.

(b) Granulated Powders-- made by Wolff & Co., for sporting purposes only.

Ballistite-- Nobel.

Collodian cotton----------40 %
Nitroglycerin-------------60 %

This powder is sold under the name of " Filite " in Italy, and is used in big guns.

Cordite-- Abel and Dewar.

Nitroglycerin----------58 %
Guncotton--------------37 %
Vaseline---------------- 5 %

Used both for sporting and military purposes.

Amberite-- Curtis and Andre.

Tri-nitro-cellulose----------44 parts.
Di-nitro-cellulose-----------12 parts.
Nitroglycerin----------------40 parts.

For military use.

Leonard's Powder-- M. E. Leonard, U. S. A.

This complex powder is made by mixing 150 parts of glycerin, 50 parts of guncotton, 10 parts of lycopodium, and 4 parts of powdered urea with acetone, for 12 hours. The mixture is then evaporated and granulated to be used in high explosive guns.

Indurite-- C. E. Munroe, U. S. A.

1 part guncotton.

0.9 to 1.8 parts Nitro-benzene.

Military powder.

Du Pont Powder---- U. S. S.

18 parts Nitro benzene.
6 parts Nitro-cellulose.

For military use.

S. R. Powder.

Di-nitro-cellulose----------28.18 %
Tri-nitro-cellulose----------46.97 %

Aurin----------1.06 %
Barium nitrate-19.97 %
Saltpeter------ 2.35 %
Volatile matter-1.45 %

Poudre B-----Vieille-- 1884.

Insoluble nitro-cellulose----------68.2 %
Soluble nitro-cellulose------------29.8 %
Paraffin---------- 2.0 %

Used in military rifles.

Poudre B. N-- Military.

Early formula:

Insoluble nitro-cellulose------29.1 %
Soluble nitro-cellulose--------41.3 %
Barium nitrate-----------------19.0 %
Saltpeter---------- 8.0 %
Soda---------- 2.0 %

Later formula.

Insoluble nitro-cellulose------38.7 %
Soluble nitro-cellulose--------33.2 %
Barium nitrate-----------------18.7 %
Saltpeter---------- 4.5 %
Soda---------- 3.6 %
Volatile matter---------- 1.3 %

Sometimes tannin is substituted in this powder for soda.

Poudre B (A M_8) --- Military (1896)

This powder has the same composition as the later B. N. powder with the addition of 2 % amyl alcohol, used to stabilize the product.

Poudre B (A M_8) --- 1897.

The same as BN, but containing 8 % amyl alcohol as a stabilizing agent.

Poudre B. F. -- Small Arms.

Soluble nitro-cellulose----------20 to 25 %
Insoluble nitro-cellulose--------51.9 to 46.9 %

Barium nitrate----------18.7 %
Saltpeter---------- 4.5 %
Soda---------- ---- 3.6 %
Volatile matter--------- 1.3 %

(Rapid burning powder.)

To make a slow-burning powder, the soluble nitro-cellulose content is increased to 50 or 55 %.

Poudre B. D.s

Same as powder B. N. with 2% diphenylamine added to stabilize.

U. S. Powder. (Pyro-Cotton.)

Nitro-cotton----------84 Pounds.
Alcohol----------26.4 "
Water---------- 3.6 "
Ether----------48.4 "
Diphenylamine--------- 6 ounces.

The mixture is filtered, compressed, and cut with a dye into long cords. Used in big guns carrying high explosive shells.

Solenite-- Italian big gun powder.

Soluble nitro-cellulose----------32 %
Insoluble nitro-cellulose--------32 %
Nitroglycerin----------33 %
Mineral jelly---------- 3 %

W. P. C. /89--- German Cube Powder.

Collodian cotton----------40 %
Nitroglycerin----------60 %

(Used in big guns.)

R. P. C. /97-- German Military Powder.

Made like solenite with the addition of diphenylamine.

R. P. C. /oo-- German big gun.

Like R. P. C. /97 but made up in tubular form.

Axite-- Strip form of Rifle Powder.

Nitroglycerin----------29.7 %
Nitro-cellulose--------63.1 %
Mineral jelly---------- 5.1 %
Volatile matter-------- 0.2 %
Saltpeter-------------- 1.9 %

Moddite-- Strip form, rifle.

Nitroglycerin----------38.7 %
Nitro-cellulose--------56.8 %
Mineral jelly---------- 4.3 %
Volatile matter------- 0.2 %

Imperial Schultze.

Nitro-lignin----------80.1 %
Barium nitrate--------10.2 %
Vaseline-------------- 7.9 %
Volatile matter------- 1.8 %

This is a slow-burning shotgun powder.

Amberite-- Shotgun Powder.

Nitro-cotton----------71.0 %
Saltpeter-------------- 1.2 %
Barium nitrate--------18.6 %
Wood meal-------------- 1.4 %
Vaseline-------------- 5.8 %
Volatile matter------- 2.0 %

S. S. Powder-- Shotgun.

Nitro-cellulose-------59.2 %
Di-nitro-toluene------15.7 %
Saltpeter-------------- 1.3 %
Barium nitrate--------17.0 %
Wood meal-------------- 5.2 %
Chalk----------------- 0.6 %
Volatile matter------- 1.0 %

Kynoch's Smokeless. -- Shotgun.

Nitro-cotton----------52.1 %
Di-nitro-toluene------19.5 %
Saltpeter-------------- 1.4 %
Barium nitrate-------- 22.2 %
Wood meal------------- 2.7 %
Ash------------------- 0.9 %
Volatile matter------- 1.2 %

Shotgun--- Rifleite.

Nitro cotton----------94.0 %
Di-nitro-toluene------ 3.5 %

Ash----------0.9 %
Volatile matter--------1.6 %

Sporting Ballistite-- Shotgun.

Nitroglycerin---------37.6 %
Nitro-cotton----------62.3 %
Volatile matter------- 0.1 %

Four common brands of French sporting powder are given below:

(1) Poudre S.

Nitro-cotton----------65.0 %
Barium nitrate--------29.0 %
Saltpeter------------- 6.0 %
Moisture-------------- 2.0 %

(2) Poudre J.

Nitro-cotton----------83.0 %
Ammonium -dichromate--14.0 %
Potassium-dichromate-- 3.0 %
Moisture--------------3.0 %

(3) Poudre M.

Nitro-cotton----------71.0 %
Barium nitrate--------20.0 %
Saltpeter------------- 5.0 %
Camphor--------------- 3.0 %
Binding material------ 1.0 %

(4) Poudre T.

Nitro-cotton----------98.5 %
Moisture-------------- 1.5 %

Tonite #I.

Guncotton--------------50.0 %
Barium nitrate---------50.0 %

This powder is used to fill cartridges and for torpedoes.

Tonite # 2 consists of Guncotton, Saltpeter, Sodium nitrate, Charcoal, and Sulphur.

Tonite # 3.

Guncotton--------------19 %
Di-nitro-benzene-------13 %
Barium nitrate---------68 %

Used for blasting and for soft rock work.

U. S. Naval Smokeless.

Nitro-cellulose----------80 %
Saltpeter---------- 4 %
Barium nitrate----------15 %
Chalk---------- 1 %

(Used in big guns.)

W. A. Powder-- Military.

Insoluble guncotton.)
Nitroglycerin.) secret.
Saltpeter.)

Prentice's Guncotton Powder.

Nitrated Paper----------15 %
Cellulose----------85 %

Punshon's Guncotton Powder.

Guncotton soaked in a solution of sugar, and then mixed with saltpeter or sodium nitrate.

Cooppal Powder-- Military.

Nitro-jute (or cotton).)
Nitrates.) secret.
Solvent to gelatinize.)

Smokeless Diamond.

Nitro-cellulose.
" Certain compounds to act as moderators. "
Solvent to gelatinize.

This shotgun powder is guarded very closely. It is a quick igniting powder due to the peculiar structure of the grains which, when examined under the microscope, have the appearance of coke.

Greiner's Powder-- Sporting.

Nitro-cellulose.
Nitro-benzol.
Graphite.
Lampblack.

Maximite-- by Hudson Maxim.

" A Nitro-compound with a gun-cotton base. " Secret formula. This powder is made for both rifles and blasting purposes.

Henrite-- a nitro-cellulose powder.

Normal Powder-- Swedish.

Guncotton----------96.21 %
Soluble cotton----- 1.80 %
Non-nitrated-cotton-trace.
Resin and other
materials------ 1.99 %

This type of powder is used in Swiss artillery service at present. It is stable, keeps well in moist atmospheres, and is not sensitive to shock or friction, and is very easily ignited.

Bracket's Sporting Powder.

An American wood powder containing soluble and insoluble nitrolignin mixed with charedd lignin, heimus and sodium nitrate.

C. F. Hengst's Powder.

Made by nitrating pulped straw which is then treated with alkalies. The resulting firm fibrous substance is granulated and loaded into shells. This powder is absolutely smokeless, and flameless, and is said to b 150 % stronger than black powder.

Mendeleef's Explosive--Military.

Pyrocellulose (containing 12.4 % nitrogen.)

U. S. Army and Navy Cannon Powder.

Nitrocellulose (containing 12.60 % = 0.1 nitrogen.)

U. S. Army and Navy Small Arms Powder.

Pyrocellulose.

U. S. Army and Navy Small Arms Powder.

Pyrocellulose.

Schultze Pulver.

Guncotton	24 %
Collodian cotton	24 %
Cellulose	13 %
Saltpeter	33 %
Paraffin	4 %
Moisture	2 %

Walsrode.

Nitrocellulose	99 %
Acetic ether	1 %

Schwab Powder.

Nitrocellulose	98 %
Volatiles	2 %

Amberite II.

Nitro-cellulose	77 %
Paraffin	10 %
Barium nitrate	11 %
Volatiles	2 %

Cordite M. D.

Guncotton	65 %
Nitroglycerin	30 %
Vaseline	5 %

Plastomenite II.

Nitro-cellulose	68 %
Di-nitro-toluene	6 %
Tri-nitro-toluene	13 %
Barium nitrate	13 %

Maxim-Schupphaus.

Guncotton	85 %
Nitroglycerin	10 %
Castor oil	5 %

R. R. Powder.

Nitrocellulose	98 %
Volatiles	2 %

Pyro-Collodian Powder.

Nitrocellulose---------98 %
Volatiles---------------2 %

CHAPTER 4.

Aromatic- Nitro-Explosives.

Picric Acid.

Hausmann, in 1788, was the first to discover picric acid. ($C_6H_2 (N O_2)_3 O H$). At that time it was used only as a dye for silk and wool but about a century later (1873), H. Sprengel discovered that this compound had high explosive properties.

In 1886. E. Turpin recommended its use in a molten condition as a bursting charge for high explosive shells and it has since been used in this connection very extensively.

Picric acid ignites and burns slowly with a very smoky flame but is somewhat sensitive to shock. Picrates, however, are extremely sensitive to shock. friction or heat. Lead Picrate being very dangerous. Ammonium picrate is now used in many powders while the acid (molten) is the chief constituent of French Melinite, English Lyddite, and Japanese Shimose. Other picric acid powders are: Grantfullung 88, Pertite, Coronite, Picrinite and Dunnite.

Tri-Nitro-Tolueme.

In a great many ways tri-nitro-toluene, $C_6H_2 (N O_2)_3 CH_3$), has replaced picric acid. In high explosives. This aromatic compound is safer than the

acid because it does not form dangerous explosive salts corresponding to the picrates. Its manufacture takes place through three successive stages, namely: mono-nitro-toluene; di-nitro-toluene, and the tri-nitro-toluene. T.N.T. or Triton, as it is commercially called, ignites and burns with a very smoky flame, it is only slightly sensitive to shock, friction or heat, but will explode if large masses are heated suddenly.

It is easily exploded with a detonator and so is used to fill time projectiles and bombs.

Donarite--- High T. N. T. Explosive.

Ammonium nitrate	80 %
Nitroglycerin	3.8 %
Collodian cotton	0.2 %
Triton	12 %
Meal	4 %

Permonite.

Ammonium nitrate	42.5 %
Potassium perchlorate	32.5 %
Triton	10 %
Starch meal	10.5 %
Wood meal	3 %
Moisture	1.5 %

Borlinetto's Formula-- (1867).

Picric acid	10 parts.
Sodium nitrate	10 parts.
Potassium chromate	8 1/2 parts.

(Used for blasting.)

Potassium picrate was used as early as 1867 by the United States and England to charge bombs.

Brugere used Ammonium picrate in his powder.

Austrian " Ecrasite " (1888) was made from Ammonium-tri-nitro-cresol.

French Picrate Powders made by Designalle:

(1) For Rifles.

Potassium picrate----------28.6 to 22.9 %
Saltpeter----------65.0 to 69.4 %
Charcoal---------- 6.4 to 7.7 %

(2) Torpedo and Shells.

Potassium picrate----------55 to 60 %
Saltpeter----------45 to 50 %

(3) Ordinary Cannon.

Potassium picrate----------16.4 to 9.6 %
Saltpeter----------74.4 to 79.7 %
Charcoal---------- 9.2 to 10.7 %

(4) Great Guns.

Potassium picrate---------- 9 %
Saltpeter----------80 %
Charcoal----------11 %

Fontaine, a French military chemist made a good powder from Potassium picrate and Potassium chlorate which he used to load shells and torpedoes. Its manufacture was discontinued, however, beacues of the extreme danger in handling the powder.

Brugere's Powder of 1869.

Ammonium picrate----------54 %
Saltpeter----------46 %

Abel's Powder of 1869.

Ammonium picrate----------40 %
Saltpeter----------60 %

Ammonium picrate has, at present, a limited use in shell filling.

Tri-Nitro-Cresol.

$C_7H_4 (NO_2)_3 OH$. This high explosive is called " Cresylite " in France, and it is used for heavy shells and torpedoes in a molten condition. Its salts have a much higher explosive property. Ammonium nitro-cresylate is either granulated or

compressed into slabs to form the powder " Ecrasite. " It makes a very stable explosive which does not detonate by blows or friction and which only burns slowly and quietly. It is twice as strong as dynamite.

Other nitro-compounds are used, not alone as explosives, but mixed with other explosive substances. These are: Mono, di and tri-nitro-benzene, di-nitro-toluene, and mono and di-nitro-naphthalene. These substances are used in low-freezing dynamites, in chlorate and nitrate powders and in safety explosives.

Nitro-Safety Explosives used in blasting.

(1) Roburite--- Dr. C. Roth.

Type (a)

1 part of chloro-nitro -naphthalene.
2 parts saltpeter.

Type (b)

1 part di-nitro-benzene.
2 parts Ammonium nitrate.

(2) Bellite-- Charles Lamm.

Type (a)

1 part di-nitro-benzene.
1.9 parts Ammonium nitrate.

Type (b)

1 part Tri-nitro-naphthalene.
1.57 parts Ammonium nitrate.

(3) Securite---------F. Schoneweg.

Paste of Ammonium nitrate and potassium or ammonium oxalate in water and dried at 176°F; add 10 parts of nitro-benzene or 20 parts of di-nitro-benzene.

(4) Ammonite-----P. A. Favier.

Types:

(a) Grisounite-- for coal.

Sodium nitrate----------95.5 %
Tri-nitro-naphthalene--- 4.5 %

(b) Griasnunite--for rock.

Sodium nitrate----------92 %
Tri-nitro- naphthalene-- 8 %

(c) Favier's Powder No. L.

Ammonium nitrate----------88 %
Di-nitro-naphthalene------12 %

(d) Favier's Powder No.2.

Ammonium nitrate----------44 %
Sodium nitrate------------40 %
Di-nitro-naphthalene------16 %

(c) Favier's Powder No.3.

Sodium nitrate----------75 %
Mono-nitro-naphthalene-- 5 %

(5) Romite-----R. Sjoberg.

Ammonium nitrate.
Nitro-naphthalene.
Potassium chlorate.
Ammonium carbonate.

(6) Carbonite.

1 part of Sulphiretter tar oil.
1/2 part Nitro-cumene.
9 to 10 parts of Sodium nitrate.

Raschig's Soluble Powder.

Sodium nitrate----------65 %
Sodium cresol-sulphonate-35 %

(Used for blasting.)

" Raschit. "

Sodium- cresol-sulhponate-----35 %
Ammonium nitrate--------------65 %

Astralit.

Di-nitro-chlor-hydrin.
Nitroglycerin.

Other chlor-hydrin -explosives are:

Gelatin wetterastralit.
Gelatin Westfalit.
Gelatin Donarit.
Perilit.

Dinitro-acetin ($C_3 H_5 (NO_3)_2 (C_2H_3O_2)$

A low freezing blasting explosive made by mixing with nitroglycerin.

Di-nitro-formin. $(C_3H_5)(NO_3)_2 (C_2H_3O_2)$ is used in the same manner for blasting. Tetra- nitro-di-glycerin is another of the same type.

Di-nitro-glycol. $(CH_2 (NO_3) CH_2 (NO_3)$ a high blasting explosive used in France which is more powerful and cheaper than nitroglycerin.

Nitro-iso-butyl-glycerin-nitrate.

$(NO_2C(CH_2NO_3)_3$. is a low-freezing liquid explosive used some in blasting.

Hexanitrodiphenylamine. $(C_6H_2N_3O_6)_2 N. H.$ is a powerful explosive but is not used as such.

2-4-6 trinitroaniline or " Pieramide. "-- a very powerful explosive but is not used yet.

Tetra- nitro-aniline. $(C_6H (N O_2)_4 N H_2)$ is the mos powerful explosive known at present (1917) It is not as sensitive as tetryl.

"Tetryl " or " tetralite ".

Tri-nitro-ohenol-nitramine, $(C_6H_2(NO_2)_3 N (CH_3) N O_2$ is a sensitive, powerful explosive used in detonators with fulminate. Common in explosive shells at present.

" Fortex "-- explosive.

Ammonium nitrate-- Tetryl.

Tetra- nitro-phenyl-methyl-nitramine. ($C_6H(NO_2)_4 N(CH_3)NO_2$. High explosive not used at present.

2-3-4-5 tetra-nitro-phenol. $C_6H(NO_2)_4 OH$-- not used as an explosive yet.

Penta-nitro-phenol, $C_6(NO_2)_5 CH$-- not used.

Styphnic Acid or 2-4-6 tri-nitro-resorcinal. $C_6H(NO_2)_3 OH)_2$. The salts of this compound are violent explosives but not put to use so far.

Tri-nitro-cresol. $C_6H\ OH\ CH_3(NO_2)_3$. Used in cresylite along with picric for shell filling.

Melinite.

Trinitrocresol	60 %
Picric acid	40 %

Tri-nitro anisole. $C_6H_2(NO_2)_3\ O\ CH_3$. Used by the Germans' to fill bombs.

Picric Acid--- to detonate lyddite.

Ammonium picrate	43 %
Saltpeter	57 %

Explosive N-3.

Sodium nitrate	58 %
Tri-nitro-naphthalene	27 %
Ammonium nitrate	15 %

Belgian Marcariti.

Tri-nitro-toluene	30 %
Lead nitrate	70%

Austrian Ammonal.

Triton	18.0 %
Ammonium nitrate	58.6 %
Charcoal	2.4 %
Aluminum	21.0 %

Plastrotyl.

Triton.
Resin. } secret.

Triplastite.

Triton, lead nitrate and liquid di-nitro-toluene. (Gelatinized with collodian cotton.)

Explosive Bomb.

Type (a) ----- 8 to 9 Kg. fused T. N. T.

Type (b) ---- Triton and hexanitrodiphenylamine.

Type (c)-------Triton and dinitrobenzene.

Detonator used is composed of 0.8 grams to 1 gram of Tetryl and Lead nitride.

Emmensite.

An American powder invented by Dr. Stephen Emmens. It is made by treating picric acid with fuming nitric, then treating the separated crystals with hot water which forms two other kinds of bodies, one of which quickly dissolves. The remaining acid crystals are mixed with saltpeter or sodium nitrate to form the powder. This type of powder is adapted to both firearms and blasting.

Explosive D. --- A non-fusible Picric Acid used by the United States Ordnance as a shell filler. It is only slightly sensitive to shock.

Triton Explosive.

Paraffin----------35 %
Ortho-nitrotoluene-50 %
Triton------------15 %
Iron filings-------51 %

CHAPTER 5.

SAFETY EXPLOSIVES.

Safety explosives are those explosives which are more or less safe toward damp-fire which may occur in the mine. They are also to a certain extent more safe to handle in firing since they require a much greater shock or impulse to bring about explosion.

Ammonite.

Ammonium nitrate----------70 to 95 %
Resin.
Meal.
Naphthalene, etc.

Sodium nitrate and potassium dichromate are sometimes added.

Koln-Rottweiler-- Safety Explosive.

Ammonium nitrate----------93 %
Linseed oil---------- 4.9 %
Sulphur----------1.2 %
Barium nitrate----------0.9 %

Sekurite.

Ammonium nitrate----------37 %
Saltpeter----------34 %
Mono-nitro-benzene---------29 %
Di-nitro-benzene----------29 %

Gestenroburite.

Ammonium nitrate----------82.5 %
Di-nitro-benzene----------17.5 %

Dynammon I.

Ammonium nitrate----------88 %
Lignite----------12 %

Ammonal.

Ammonium nitrate----------72 %
Powdered aluminum---------23.5 %
Lignite---------- 4.5 %

Anagon-- Explosive Powder.

Ammonium nitrate	84. 5 %
Saltpeter	1. 5 %
Charcoal	8 %
Powdered Aluminum	5. 5 %
Barium nitrate	0. 5 %

Oxyliquit.

Liquid Air	80 %
Burnt cork	10 %
Paraffin	10 %

Dahmenit.

Ammonium nitrate	91.3 %
Naphthalene	6.5 %
Potassium dichromate	2.2 %

Roburit I.

Ammonium nitrate	87.5 %
Di-nitrobenzene	7 %
Potassium permanganate	0.5 %
Ammonium sulphate	5 %

Westfalit.

Ammonium nitrate	91 %
Saltpeter	4 %
Resin	5 %

Antigrison Favier II.

Ammonium nitrate	80.9 %
Di-nitronaphthalene	11.7 %
Ammonium chloride	7.4 %

Ammon-carbonite.

Ammonium nitrate	82 %
Saltpeter	10 %
Nitroglycerin	3.8 %
Collodian cotton	0.2 %
Meal	4 %

Grisoutine B.

Ammonium nitrate	88 %
Nitroglycerin	11.75 %
Collodian cotton	0.25 %

Nobelite.

Ammonium nitrate	41.5 to 39.7 %
Salt	25.6 to 17.6 %
Nitroglycerin	28 %

Collodian cotton---------- 0.7 %
Dextrin----------11 %
Wood oil----------0.5 %
Wood meal----------2.5 %

Amid Powder--- Hamburg.

Saltpeter----------40 %
Ammonium nitrate----38 %
Charcoal----------22 %

Slight smoke but no great energy.

Sprengel's Explosives. ------- (1873).

( ) Hellhoffite.)
) Liquid.
(2)Panclastic.)

Consist of Nitrobenzene and Picric Acid in Nitric Acid.

Solid----- Potassium chlorate replaces the Nitric Acid as the Oxygen Carrier.

Westfalit II.

Resin----------6 1/2 parts.
Ammonium nitrate-60 parts.

Used in filling blasting cartridges.

French Blasting Explosives.

(1) For Rock.

Collodian cotton----------20 %
Ammonium nitrate----------80 %

(2) For Coal.

Collodian cotton---------- 9.5 %
Ammonium nitrate----------90.5 %

Grison-Naphthalite Cauche.

	N_a	N_4
Ammonium nitrate------	95 %	90 %
Saltpeter----------		5 %
Tri-nitronaphthalene-	5 %	5 %

Grison -Naphthalite-Roche.

N.b.

Ammonium nitrate-----	91.5 % -----	86.5 %
Saltpeter----------	----------	5 %
Di-nitronaphthalene--	8.5 % -----	8.5 %

Grison Tetrylite- Couche.

Ammonium nitrate----------	88.0 %
Saltpeter----------	5 %
Tetryl----------	7 %

N. C.

Ammonium nitrate----------	87.4 %
Di-nitronaphthalene-------	12.6 %

Ammonite # I.

Ammonium nitrate----------	75 %
Triton----------	5 %
Salt----------	20 %

Bellite # 2.

Ammonium nitrate----------	61 %
Di-nitrobenzene----------	12 %
Salt----------	27 %

Bellite # 4.

Ammonium nitrate----------	66 %
Di-nitrobenzene----------	14 %
Salt----------	20 %

Faversham Powder.

Ammonium nitrate----------	47.5 %
Saltpeter----------	24 %
Triton----------	10 %
Ammonium chloride---------	18.5 %

Negro Powder # 2.

Ammonium nitrate----------	57 %
Triton----------	15 %
Salt----------	27.5 %
Graphite----------	0.5 %

Roburite # 4.

Ammonium nitrate----------	61 %
Triton----------	16 %
Salt----------	23 %

Densite-- 4.

Ammonium nitrate----------	18 %

Saltpeter----------45.5 %
Triton-------------19 %
Ammonium chloride--17.5 %

Favier--3-bis.

Ammonium nitrate----------60 %
Saltpeter----------11 %
Potassium permanganate---- 0.5 %
Triton---------- 8.5 %
Flour---------- 6 %
Alum---------- 5 %
Ammonium chloride--------- 4 %
Barium carbonate---------- 5 %

Densite--- 3.

Ammonium nitrate----------74 %
Sodium nitrate-----------22 %
Triton---------- 4 %

Poudre blanche Cornil--- bis.

Ammonium nitrate----------77 %
Saltpeter---------- 1 %
Lead chromate---------- 1 %
Di-nitronaphthalene------ -3 %
Ammonium chloride--------- 18 %

Favier-- 2 bis.

Ammonium nitrate----------77.6 %
Di-nitronaphthalene------- 2.4 %
Ammonium chloride---------20 %

Fractorite B.

Ammonium nitrate----------75 %
Di-nitronaphthalene------- 2.8 %
Ammonium oxalate---------- 2.2 %
Ammonium chloride---------20 %

Minolite Anti-grisoutens.

Ammonium nitrate----------72 %
Sodium nitrate-----------23 %
Triton---------- 3 %
Tri-nitronaphthalene------ 2 %

Roburite 2.

Ammonium nitrate----------71.5 %
Saltpeter---------- 5 %
Potassium permanganate---- 0.5 %

Triton----------12 %
Flour---------- 6 %
Salt---------- 5 %

Roburite 3.

Ammonium nitrate----------55 %
Saltpeter---------- 9.5 %
Potassium permanganate-----0.5 %
Triton----------12%
Flour---------- 6 %
Ammonium chloride---------- 5 %
Salt---------- 7 %
Magnesite---------- 5 %

Nen-Wesfalite.

Ammonium nitrate----------70.3 %
Di-nitrotoluene----------10.9 %
Flour---------- 2 %
Salt----------16.8 %

Gluckauf AI.

Ammonium nitrate----------70.4 %
Saltpeter----------10 %
Di-nitrobenzene---------- 1 %
Wood meal---------- 6.4 %
Fennel---------- 7.2 %
Copper oxalate---------- 5 %

Gluckauf A III.

Ammonium nitrate----------82.7 %
Di-nitrobenzene---------- 1 %
Wood meal----------11.5 %
Copper oxalate---------- 4.8 %

Dahmenit.

Ammonium nitrate----------91.3 %
Potassium dichromate------ 2.2 %
Naphthalene---------- 6.5 %

Dorfit-- Coal mining.

	I	II
Ammonium nitrate	65 %	61 %
Saltpeter	5 %	5 %
Triton	6 %	15 %
Rye flour	4 %	4 %
Salt	20 %	15 %

Aldorfit-

Ammonium nitrate	81 %
Triton	17 %
Rye flour	2 %

Fulmenit.

Ammonium nitrate	86.5 %
Gun cotton	4 %
Triton	5. 5 %
Paraffin oil	2.5 %
Charcoal	1.5 %

Wetter- fulmenite.

Ammonium nitrate	76.5 %
Gun cotton	4 %
Triton	5.5 %
Paraffin oil	2.5 %
Charcoal	1.5 %
Salt	10 %

Monachit I.

Ammonium nitrate	81 %
Saltpeter	5 %
Tri-nitro-xylene	13 %
Flour	1 %

Monachit II d.

Ammonium nitrate	64 %
Saltpeter	3 %
Sodium nitrate	3 %
Tri-nitro-xylene	12 %
Collodian cotton	1 %
Charcoal	1 %
Salt	19 %

Aerolit-----Denmark.

Ammonium nitrate	78.125 %
Saltpeter	7.5 %
Sulphur	8.75 %
Fat(beef suet)	2.5 %
Sago flour	1.25 %
Manganese dioxide	1.25 %
Resin	0.625 %

Weter-dynammon-- (Austrian.)

Ammonium nitrate	94 %
Saltpeter	2 %
Charcoal	4 %

Ammonal B.

Ammonium nitrate----------93 to 95.5 %
Aluminum---------- 2.5 to 3.5 %
Charcoal---------- 2 to 3 %
Moisture---------- 0 to 1 %

Ripping Ammonal.

Ammonium nitrate----------84 to 87 %
Aluminum---------- 7 to 9 %
Charcoal---------- 2 to 3 %
Potassium dichromate-------3 to 4 %
Moisture----------0 to 1 %

St. Helen's Powder.

Ammonium nitrate----------92 to 95 %
Aluminum---------- 2 to 3 %
Triton---------- 3 to 5 %
Moisture---------- 0 to 1 %

Blasting Ammonal.

	I	II
Ammonium nitrate	72 %	47 %
Aluminum	25 %	22 %
Charcoal	3 %	1 %
Triton	0 %	30 %

Telsit A.

A Swiss Powder like Ammonal but containing Di-nitrotoluene in place of Tritol.

Sabulite-- (for coal.)

Ammonium nitrate----------54 %
Saltpeter----------22 %
Calcium sulphide----------5 %
Trotyl----------6 %
Ammonium chloride----------13 %

Monabel I.

Nitroglycerin----------8.5 %
Ammonium nitrate-------68 %
Wood meal---------- 8.5 %
Salt----------15 %

Monabel # A.

Nitroglycerin----------10 %
Ammonium nitrate-------60 %
Wood meal--------------10 %
Potassium chloride-----20 %

Super-Excellite.

Type I.

Nitroglycerin----------4.0 %
Ammonium nitrate-------75.5 %
Saltpeter--------------- 7.0 %
Starch------------------ 3.5 %
Ammonium oxalate-------10 %

Type II.

Nitroglycerin---------- 5 %
Ammonium nitrate-------50 %
Saltpeter--------------20 %
Starch------------------ 5 %
Ammonium oxalate-------15 %
Ammonium chloride------ 5 %

Type III.

Nitroglycerin----------9.5 %
Collodian cotton------- 0.5 %
Ammonium oxalate-------10.5 %
Ammonium nitrate-------59 %
Starch------------------ 4.5 %
Salt--------------------15 %
Castor oil-------------- 1 %

Monarkite.

Nitroglycerin----------12 %
Collodian cotton------- 0.3 %
Ammonium nitrate-------49.7 %
Sodium nitrate----------7.5 %
Starch-------------------4 %
Mineral jelly-----------2 %

Fractorite D.

Nitroglycerin---------- 4%
Ammonium nitrate-------75 %
Sodium nitrate---------10 %
Ammonium oxalate------- 7 %
Carbohydrates---------- 4 %

Flaminivore III.

Nitroglycerin---------- 6 %
Ammonium nitrate-------70 %
Carbohydrates---------- 8 %

Ammonium sulphate----------9 %
Barium sulphate-----------7 %

Ammon-Carbonite.

Nitroglycerin---------- 4 %
Ammonium nitrate-------82 %
Saltpeter--------------10 %
Carbohydrates---------- 4 %

Colinite Antigrisoutense.

Nitroglycerin----------25 %
Collodian cotton------- 1 %
Ammonium nitrate-------20 %
Potassium perchlorate-- 6 %
Triton-----------------12 %
Cellulose and flour----29 %
Magnesium sulphate----- 1 %

Salit.

Nitroglycerin----------11.8 %
Collodian cotton------- 0.5 %
Ammonium nitrate-------53.6 %
Di-nitrotoluene-------- 8.5 %
Salt-------------------23.1 %
Carbohydrates---------- 2.5 %

Tremonit.

Di-nitroglycerin----------33.0 %
Collodian cotton---------- 1.0 %
Ammonium nitrate----------26.5 %
Triton---------------------2.5 %
Salt----------------------25.0 %
Carbohydrates-------------12.0 %

Donarit.

Nitroglycerin---------- 3.8 %
Collodian cotton------- 0.2 %
Ammonium nitrate-------80.0 %
Triton-----------------12.0 %
Carbohydrates---------- 4.0 %

Ammonium-karbonit I.

Nitroglycerin---------- 4 %
Collodian cotton------- 0.2 %
Ammonium nitrate-------80.3 %
Saltpeter-------------- 5.0 %
Carbohydrates---------- 4.5 %
Coal dust-------------- 6.0 %

Astralit.

Astralit.

Nitroglycerin	4 %
Ammonium nitrate	84.5 %
Triton	7.0 %
Wood meal	1 %
Charcoal	1 %
Paraffin oil	2.5 %

Wetter Astralit.

Nitroglycerin	4 %
Ammonium nitrate	74.5 %
Salt	10.0 %
Triton	7 %
Wood meal	1 %
Charcoal	1 %
Paraffin oil	2.5 %

Pannonit----- (Austrian.)

Nitroglycerin	25.5 %
Collodian cotton	1.5 %
Ammonium nitrate	37 %
Dextrin	4 %
Glycerin	3 %
Nitrotoluene	5 %
Salt	24 %

French Schneiderite--- Military.

Ammonium nitrate	88 %
Di-nitronaphthalene	11 %
Resin	1 %

Faversham Powder (for coal.)

Triton	11 parts.
Ammonium nitrate	93 parts.
Moisture	1 part.

Electronite (for coal.)

Ammonium nitrate	75 %
Barium nitrate	25 %
Wood meal	25 %
Starch	25 %

A very safe powder which does not ignite either fire damp or coal dust.

Astralit.

Nitroglycerin----------	4 %
Ammonium nitrate--------	84.5 %
Triton----------	7.0 %
Wood meal----------	1 %
Charcoal----------	1 %
Paraffin oil----------	2.5 %

Wetter- Astralit.

Nitroglycerin----------	4 %
Ammonium nitrate--------	74.5 %
Salt----------	10.0 %
Triton----------	7 %
Wood meal----------	1 %
Charcoal----------	1 %
Paraffin oil----------	2.5 %

Panmonit-- (Austrian.)

Nitroglycerin----------	25.5 %
Collodian cotton--------	1.5 %
Ammonium nitrate--------	37 %
Dextrin----------	4 %
Glycerin----------	3 %
Nitrotoluene----------	5 %
Salt----------	24 %

French Schneiderite-- Military.

Ammonium nitrate----------	88 %
Di-nitronaphthalene--------	11 %
Resin----------	1 %

Faversham Powder-- for coal.

Ammonium nitrate----------	93 parts.
Triton----------	11 parts.
Moisture----------	1 part.

Electronite-- for coal.

Ammonium nitrate----------	75 %
Barium nitrate----------)	
Wood meal----------)	25 %
Starch----------)	

A very safe powder which does not ignite either fire damp or coal dust.

Ammonium Dynamite.

Ammonium nitrate----------75 %
Paraffin---------- 4 %
Charcoal---------- 3 %
Nitroglycerin----------18 %

Omnus.

Ammonium nitrate----------90 %
Chloro-di-nitrobenzene-----5 %
Wood pulp----------5 %

Favierite No.2.

No. I Powder----------90 %
Ammonium chloride-----10 %

Favierite No. I.

Ammonium nitrate----------88 %
Di -nitronaphthalene------12 %

Withnell Powder-- Blasting.

Ammonium nitrate----------88 to 92 %
Triton---------- 4 to 6 %
Flour---------- 4 to 6 %
Moisture---------- 0 to 1.5 %

Explosive by H. C. L. Bloxam.

Ammonium nitrate and Di-nitrobenzene are melted and mixed, solidified and granulated into a powder for cartridges.

Gesteinsdorfit.

Ammonium nitrate----------66 %
Saltpeter---------- 5 %
Triton----------15 %
Salt----------10 %
Rye meal----------4 %

Chrome- Ammonite-- for coal.

Ammonium nitrate----------66 %
Saltpeter----------14.5 %
Chrome alum----------10 %
Collodian cotton---------- 9 %
Vaseline---------- 0.5 %

Explosive--- by C. R. Jahn.

Nitroglycerin---------- 4 %
Hexanitrodiphenyl------12 %

Good Luck.

Ammonium nitrate----------82 %
Di-nitrobenzene---------- 1 %
Tumeric----------10.5 %
Copper oxalate---------- 6 %
Moisture---------- 0.5 %

Virite.

Ammonium nitrate----------37.5 %
Saltpeter----------35.5 %
Sulphur---------- 4.5 %
Charcoal----------11.5 %
Ammonium oxalate----------10.5 %

Odite.

Ammonium nitrate---------- 88 %
Di-nitrotoluene----------12 %
Moisture----------1/4 %

Thunderite.

Ammonium nitrate----------92 %
Triton---------- 4 %
Flour---------- 4 %

CHAPTER 6.

In this class of explosives Chlorates and perchlorates are substituted for Saltpeter and Sodium nitrate as oxygen carriers. They are very sensitive to shock and friction but it has recently been discovered that by the addition of certain fatty oils this sensitivity can be greatly reduced. An explosive made by Street is made by intimately mixing potassium chlorate with aromatic nitro-compounds and either an animal or vegetable oil. The nitro-compounds are dissolved in the warmed oil and then

the Potassium chlorate is stirred into plastic cartridges. Cheddite is the most widely used chlorate powder, it being originally an English Military Powder. Ordinarily Cheddite will analyse about as follows:

Potassium chlorate----------80 %
Nitronaphthalene------------10 %
Di-nitrotoluene------------- 2 %
Castor oil------------------- 8 %

The French Government uses several types of Cheddite in their guns.

Q. Type 41.

Potassium chlorate----------80 %
Castor oil------------------- 8 %
Mono-nitronaphthalene-------12 %

Q. Type 60 bis.

Potassium chlorate----------80 %
Castor oil------------------- 5 %
Mono-nitronaphthalene-------13 %
Di-nitronaphthalene--------- 2 %

Q. Type 60 bis M.

Potassium chlorate----------79 %
Castor oil------------------- 5 %
Mono-nitronaphthalene------- 1 %
Di-nitronaphthalene---------15 %

Qa.

Sodium chlorate----------79 %
Castor oil---------------- 5 %
Di-nitrotoluene----------16 %

Cheddite 0.2 and 0.5 are the same as 60 bis M.

Cheddite Qa.

Potassium chlorate----------90 %
Paraffin--------------------10 %

Cheddite S.

Sodium chlorate-----------89 %
Paraffin------------------11 %

Cheddite # 60.

Cheddite # 60.

Potassium chlorate----------80 %
Castor oil---------- 6 %
Mono-nitronaphthalene-------12 %
Picric Acid---------- 2 %

Selesia A.

Potassium chlorate-------- -75 %
Nitrated resin----------25 %

Himly Powder.

Potassium chlorate----------45 %
Saltpeter----------35 %
Coal Pitch----------20 %

Poudre des mineurs----Michalowsky.

Potassium chlorate----------50 %
Manganese---------- 5 %
Bran----------45 %

Comet Powder--- (American).

Potassium chlorate----------75 %
Pine resin----------25 %

Melland's Shooting Powder.

Potassium chlorate----------9 parts.
Saltpeter----------4.5 parts.
Potassium ferrocyanide------3 1/4 parts.
Charcoal----------3 1/4 parts.
Ground Starch----------1/21 part.
Potassium chromate----------1/16 part.
Water----------79 parts.

The above mixture is boiled after which unsized paper is dipped into it, and later dried. The dried paper is coated with a mixture consisting of 1 part nitrocellulose and 3 parts Acetic ether.

Augendre's Powder.

Potassium chlorate----------49 %
Sugar----------23 %
Potassium ferrocyanide------28 %

Vigorite.

Nitroglycerin----------30 %
Potassium chlorate------49 %
Saltpeter---------- 7 %

Wood pulp----------9 %
Magnesium carbonate--------)
Moisture-------------------) 5 %

" White Gunpowder. "

(1) Pohl's Powder.

Potassium chlorate----------49 %
Potassium ferrocyanide------28 %
Sugar-----------------------23 %

(2) Revely.

Potassium chlorate----------48 %
Potassium ferrocyanide------29 %
Sugar-----------------------23 %

Sprengel Explosives.

"Promenthee. "

	a	b	c
Potassium chlorate	95 %	90 %	80 %
Manganese dioxide	5 %	10 %	20 %

	1	2
Nitrobenzene	50 %	60 %
Turpentine	20 %	15 %
Naptha	30 %	25 %

Mix a,b or c with 1 or 2 in the proportion of 87 to 92 %, oxygen carrier to 8 to 13 % combustible.

Sebomite.

Potassium chlorate----------90 %
Tallow--------------------)
Di-nitrobenzene-----------) 10 %

Minelite or Cheddite 06.

Potassium chlorate----------90 %
Mineral jelly-------------) 10 %
Paraffin-----------------)

Steelite.

Potassium chlorate with a coating of oxidized resin.

Silesia 4.

Potassium chlorate----------80 %
Resin-----------------------20 %

Colliery Steelite.

Potassium chlorate	72.5 to 75.5 %
Oxidized resin	23.5 to 26.5 %
Castor oil	0.5 to 1 %
Moisture	0 to 1 %

Silesia No.5

Potassium chlorate	79.2 %
Oxidized resin	15.8 %
Aluminum	5 %

Silesia IV--22.

Potassium chlorate	70 %
Oxidized resin	8 %
Salt	22 %

Chloratit--An Austrian chlorate powder used in coal mines.

Permonite 1.

Potassium perchlorate	30 %
Ammonium nitrate	40 %
Sodium nitrate	7 %
Triton	15 %
Flour	4 %
Wood meal	3 %
Jelly--(1 part glycerin.) (3 parts gelatin.)	1 %

Permonite S. G. P.

Potassium perchlorate	24.5 %
Nitroglycerin	6 %
Ammonium nitrate	29 %
Triton	7 %
Salt	25 %
Flour	4 %
Wood meal	3 %
Jelly	1 %

Permonite-- Ordinary.

Potassium perchlorate	31 to 34 %
Nitroglycerin	3 to 4 %
Collodian cotton	0.5 to1%
Ammonium nitrate	39 to 43 %
Triton	11 to 13 %
Starch	5 to 9 %
Wood meal	1.5 to 3.5 %
Moisture	0 to 2.5 %

Wetter-Persalit.

Like Permonite 1.

Alkalsit.

Like Permonite 1.

Polarite.

English secret powder.

Dynobel.

Potassium perchlorate	27 %
Nitroglycerin	32.5 %
Collodian cotton	0.7 %
Ammonium nitrate	29.5 %
Wood meal	10.3 %

Neonal.

Potassium perchlorate	37 %
Nitroglycerin	21 %
Collodian cotton	0.8 %
Di-and tri-nitrotoluene	0.2 %
Ammonium oxalate	25 %
Wood meal	16 %

Neonal #1.

Potassium perchlorate	14 %
Nitroglycerin	40 %
Collodian cotton	2.8 %
Ammonium nitrate	39 %
Wood meal	5 %

Ajax Powder.

Potassium perchlorate	37.2 %
Nitroglycerin	22.5 %
Collodian cotton	0.8 %
Di-and tri-nitrotoluene	3.5 %
Ammonium oxalate	2.5 %
Wood meal	11 %

Swale Powder.

Potassium perchlorate	37.5 %
Nitroglycerin	19 %
Collodian cotton	1 %
Di-and tri-nitrotoluene	4 %
Ammonium oxalate	28 %
Wood meal	10.5 %

French Ammonium Perchlorate Explosives.

Type 1.

Ammonium perchlorate	82 %
Di-nitrotoluene	13 %
Castor oil	5 %

Type 2.

Ammonium perchlorate----------50 %
Di-nitrotoluene----------15 %
Sodium nitrate----------30 %
Castor oil---------- 5 %

Belgian " Yonckites. "

Type --10 bis.

Ammonium perchlorate----------25 %
Ammonium nitrate----------30 %
Sodium nitrate----------15 %
Triton----------10 %
Salt----------20 %

Type # 13.

Ammonium perchlorate----------30 %
Ammonium nitrate----------27 %
Sodium nitrate----------27 %
Barium nitrate---------- 6 %
Triton----------20 %

Blastine.

Ammonium perchlorate and sodium nitrate mixed with combustibles such as Di-nitrotoluene and paraffin. This type of explosive is widely used at present.

Kinelite.

Nitrobenzene----------19.4 %
Potassium chlorate----76.9 %
Antimony sulphide----)
Nitro- cotton--------) 3.7 %

Victorite.

Potassium chlorate----------80 parts.
Picric acid----------110 1/2 parts.
Olive oil----------to moisten.
Saltpeter----------10 parts.
Charcoal---------- 5 parts.

This powder is very sensitive to friction and percussion.

Tschiner's Powder.

Very similar to Victorite, but contains resin.

Ammonia Nitrate Powder.

Ammonium nitrate----------80 %
Potassium chlorate--------- 5 %

Nitroglucose----------10 %
Coal tar---------- 5 %

Chlorated explosive----Leon Thomas.

A solid nitrated derivitive of toluene is melted and mixed with potassium chlorate in the proportion of 25 to 75.

CHAPTER 7.

DETONATORS AND PRIMERS.

By far the most important detonator of modern times is Mercury Fulminate, $Hg(CNO)_2$. It was discovered in 1799 by Howard, who made it by dissolving 1 part of Mercury in 13 parts of Nitric Acid of 1.36 specific gravity and pouring into 8 parts of Alcohol. The washed residue, free from acid, was found to detonate by blow, heat or friction.

In most common detonators a mixture of Fulminate and Potassium chlorate is used, enclosed in a copper capsule. Recently most of the Fulminate has been replaced by other nitro-compounds such as Picric Acid, Tri-nitrotoluene and Tetra-nitromethyaniline. Other primers used are:

1. Diazobenzene nitrate.
2. Sulphur nitride-- $N_4 S_4$.
3. Silver hydronitride.
4. Tri-mercuraldehyde perchlorate.
5. Tri-mercuraldehyde chlorate.
6. Sodium fulminate.
7. Basic-mercuric-nitromethane.

Mercury Fulminate explodes with extreme violence evolving gaseous Nitrogen, Carbon dioxide and Mercury vapors.

The pure fulminate will not detonate with pressure alone, but if mixed with ground glass, powdered coke or sand it explodes very readily. It can only be used as a primer, for if used as a shell charge the impulse would be so sudden that it would demolish the strongest barrell.

Silver Fulminate and Gold Fulminate are so

extremely sensitive to friction and shock that they can not be used as primers.

Composition of Caps.

Great Britian.

1. Rifle.

Mercury fulminate----------2 1/4 parts.
Potassium chlorate---------2 1/4 parts.
Antimony sulphide----------1 1/2 parts.

No.2-- Big Guns.

Mercury fulminate----------3 parts.
Potassium chlorate---------1 1/2 parts.
Antimony sulphide----------1 1/2 parts.

Swiss Caps.

Fulminate----------600 g.
Potassium chlorate- 75 g.
Ground glass-------300 g.
Gum Arabic--------- 45 g.

Detonator-- By W. Runge, 1917.

Lead nitride----------80 %
Triton----------20 %

Detonator-- By O.Matter.

Lead Nitride.
Nitropentaerythrol.

Primer-- By K. W. Will.

Tetra-nitromethyaniline----------50 %
Mercury Fulminate----------50 %

Detonator.

Potassium chlorate---------- 4 parts.
Sulphur---------- 1 part.
Mercury acetylide---------- 2 parts.

Detonator.

Potassium chlorate----------60 parts.
Fulminate----------60 parts.
Aluminum powder---------- 5 parts.
Silver acetylide----------20 parts.
